The early composite ships were classed as experimental, and subject to biennial survey, in order that the condition of the fastenings might be examined, and the effects of the galvanic action set up by the iron framing and yellow metal sheathing ascertained from time to time.

So far back as 1862, applications were made for vessels to be classed which were to be built with puddled steel, but in the absence of experience regarding the durability of steel, the Committee of Lloyd's Register felt it was not in their power to sanction the proposal.

In 1864, however, a steam yacht of 2400 tons was built for the Viceroy of Egypt under the survey of Lloyd's Register Surveyors, and constructed partly of steel. A reduction of about one-fourth was allowed in the steel scantlings from those required for an iron ship of the same size.

In April, 1876, Mr. James Riley, then manager of the Siemens Steel Works at Landore, read a paper before the Institution of Naval Architects on the production of mild steel, setting forth the results of experiments that had been made with steel manufactured by the Siemens-Martin or open hearth process, and showing the qualities of this material as to ductility and tensile strength.

These results were placed before the Committee of Lloyd's Register, and in 1877 plans from Messrs. J. Elder & Co. were approved for the construction of two paddle steamers to be

tonnage of steamers and sailing vessels of iron and steel built and registered in the United Kingdom since 1880.

Soon after the introduction of mild steel for shipbuilding purposes, attention was given to the making of heavy steel castings to take the place of iron forgings for stern frames, rudders, propeller brackets, stems, quadrant tillers, &c. These castings are required to be subjected to certain tests, and at the present time are often adopted in place of iron forgings.

It may be here remarked that, notwithstanding the early doubts as to the durability of steel, experience has shown that where proper care is taken to thoroughly clean and paint the surfaces, the deterioration is not appreciably greater than that of iron. In some parts, however, such as thin deck plating, and plating of inner bottom and floors under boilers, steel appears to be more liable to deteriorate, and in consequence of this, iron is often used for these parts in vessels otherwise constructed of steel.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—An appointment will ere long be made to the new Wykeham professorship of physics, which will be endowed in accordance with statute by New College. It is understood that a portion of the space to be vacated in the University Museum by the removal of the Radcliffe Library will be utilised, at least temporarily, as a laboratory for the teaching of electricity.

Merton College proposes to contribute, out of its University Purposes Fund, the sum of 700*l*. towards the cost of fitting up, and 500*l*. towards that of maintaining for two years, the new electrical laboratory, provided that no further liability be hereby undertaken by the College. This proviso is intended to guard against the College University Purposes Fund being regarded as a permanent source of income. Messrs. W. Peterson, principal of McGill University, and John Fletcher, professor of Latin in the University of Toronto, have been appointed as representatives of the University at the centenary of the University of New Brunswick, and Mr. W. R. Morfill, reader in Russian, has been appointed representative at the five-hundredth anniversary of the University of Cracow.

The statute making the degrees of B.C.L. and D.C.L. accessible to persons who have obtained a degree in arts in other Universities, and study law in Oxford although they have not been admitted to the degree of B.A., has been approved by Congregation and Convocation; and also the decree instituting the new research degrees of Doctor of Letters and Doctor of Science.
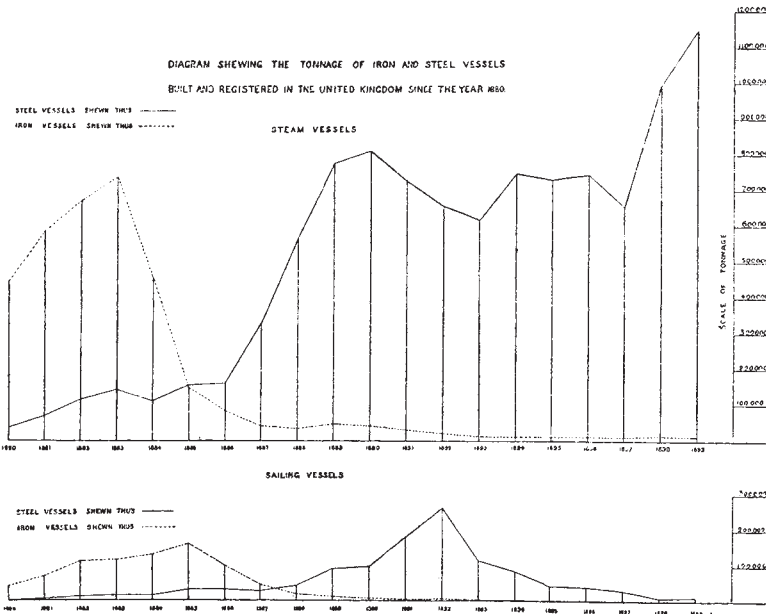
It is proposed that the necessary qualification for intending candidates for the diploma in Geography shall be that candidates give satisfactory evidence that they have received a good general education, and not, as at first suggested, that they should have passed the examination for the B.A. degree.

On May 22 the honorary D.C.L. degree was conferred upon the following colonial representatives:—The Hon. Alfred Deakin, the Hon. James R. Dickson, C.M.G., and the Hon. Sir Philip O. Fysh, K.C.M.G.

The 212th meeting of the Oxford University Junior Scientific Club was held on Friday, May 11. Papers were read by Mr. S. A. Ionides, Balliol, on "Microphotography," and by Mr. P. Elford, St. John's, on "Chemists of the Nineteenth Century." The following papers will be read during the course of the present term:—"Musical Tetanus," Prof. Sir John Burdon Sanderson, F.R.S.; "The Labile Hydrogen Atom," Mr. A. F. Walden, New College; "A Method for Measuring the Diameter of the Earth," Rev. T. C. Porter.

DIAGRAM SHEWING THE TONNAGE OF IRON AND STEEL VESSELS BUILT AND REGISTERED IN THE UNITED KINGDOM SINCE THE YEAR 1880

STEEL VESSELS SHEWN THUS ————
IRON VESSELS SHEWN THUS ········

STEAM VESSELS

SAILING VESSELS

STEEL VESSELS SHEWN THUS ————
IRON VESSELS SHEWN THUS ········

built of this material for the English Channel service, with a reduction of about 20 per cent. in the scantlings which had been adopted for iron vessels.

In the same year, in consequence of a report which may be found in the volume of *Transactions* of this Institution for 1877, it was decided to admit steel with scantlings 20 per cent. lighter than prescribed for iron, in vessels building for classification, subject to the material having a tensile strength of from 26 to 30 tons per square inch, and an elongation of 20 per cent. on a length of eight inches. These limits of tensile strength have since been raised to 28–32 tons.

The progress in the use of mild steel for shipbuilding purposes may be judged from the fact that while in 1878 seven steel vessels, of 4470 tons, were classed in Lloyd's Register, and 435 iron vessels, of 517,692 tons, the record for the year 1885 showed 118 steel vessels, of 165,437 tons, as compared with 260 iron vessels, of 290,429 tons. As wood was superseded by iron as a material for shipbuilding, so in its turn iron has given place to steel. Of the total output of the United Kingdom during the past year, 98·8 per cent. of the tonnage was built of steel, and 1·1 per cent. of iron. The iron tonnage was principally made up of trawlers, and comprised no vessel of more than 303 tons.

The accompanying diagram shows the relative changes in the

CAMBRIDGE.—Dr. J. W. L. Glaisher, F.R.S., has been appointed by the council of the Senate a governor of St. Paul's School.

Sydney University, New South Wales, has been placed on the list of recognised schools of medicine.

The Rev. T. Wiltshire has founded a prize to be awarded annually for proficiency in geology and mineralogy. The prize is open to members of the University who have passed Part i. of the Natural Sciences Tripos, and are not of more than ten terms' standing.

Prof. J. Ward and Prof. R. Adamson, of Glasgow, are appointed electors to the Gerstenberg studentship in philosophy, open to students of natural science.

Prof. Leon Guignard has been appointed director of the Paris School of Pharmacy.

Prof. Ludwig Boltzmann, of Vienna, has accepted the invitation to the chair of physics in the University of Leipzig.

The *Chemist and Druggist* announces that Prof. Moissan has been elected a member of the Paris Superior Council of Public Instruction, in succession to the late M. Planchon, deceased. He has also accepted the important post of professor of chemistry at the Paris Sorbonne, in place of M. Troost, who retires on account of advancing age.

SCIENTIFIC SERIALS.

American Journal of Science, May.—Notes on the geology of the Bermudas, by A. E. Verrill. The present Bermuda Islands are the remnant of a very much larger island, covering an area of about 300 to 400 square miles. A subsidence of at least 80 to 100 feet took place at a comparatively recent period. The Greater Bermuda, as well as the present Bermudas, are composed of shell sand drifted from the sandy flats by the winds in former times into hills, and afterwards consolidated by infiltration and exposure into what is known as Aeolian limestone. The shell sand is constantly increasing in amount, chiefly by the annual growth and death of small shells, as in former periods, so that the total mass of the islands is probably still increasing beneath the sea. The "red soil" of Bermuda is mainly the residue left after the destruction and solution of the limestones. The islands rest on the hidden summit of an ancient volcano. —Some boiling point curves, by C. L. Speyers. The author shows that the equation

$$\frac{n}{N+n} = \frac{p-p'}{p}$$

accounts for the boiling point curves of every mixture for which the partial pressures of the constituents are known at some temperature not very far from the boiling point of the mixture under consideration.—Action of ammonium chloride upon natrolite, scolecite, prehnite and pectolite, by F. W. Clarke and G. Steiger. The authors show how the ammonium chloride reaction can be used for studying the chemical structure of these minerals, and that the orthosilicate formulæ for natrolite and scolecite must be discarded.—Siliceous calcites from the Bad Lands, Washington County, South Dakota, by S. L. Penfield and W. E. Ford. The calcites obtained from the new locality have a peculiar crystallisation, being steep hexagonal pyramids instead of rhombohedra.—Studies in the Cyperaceæ, by T. Holm. This paper deals with the segregates of *Carex filifolia*, Nutt.—Mineralogical notes, by A. F. Rogers. Describes various peculiar forms of gypsum and calcite. Twinned gypsum crystals from Lebo, Kansas, possess hemimorphic orthorhombic symmetry rather than monoclinic.—The Hayder Creek, Idaho, meteoric iron, by W. E. Hidden. This meteorite, weighing 870 grammes, was found at the bottom of a twelve-foot shaft. No companions have been found.—Explorations of the *Albatross* in the Pacific, by Alexander Agassiz. This is the author's fourth and last letter to the U.S. Fisheries Commissioner on the cruise of the *Albatross*. It describes the work in the Ellice, Gilbert and Marshall Islands, as well as the Carolines and Ladrones. The Truk Archipelago was perhaps the most interesting of the island groups of the Carolines, and it is the only group of the volcanic islands surrounded by an encircling reef which the author has seen in the Pacific, which at first glance lends any support to the theory of the formation of such island groups as Truk by subsidence. But a closer examination shows that this group is not an exception to the general rule thus far obtaining in all the island groups of the Pacific visited during this trip, that we must look to submarine erosion and to a multitude of local mechanical causes for our explanation of the formation of atolls and of barrier and encircling reefs, and that, on the contrary, subsidence has played no part in bringing about existing conditions of the atolls of the South and Central Pacific.

American Journal of Mathematics, vol. xxii. 2.—Remarks concerning the expansions of the hyperelliptic sigma-functions, by Oskar Bolza, are supplementary to two papers, by the same writer, in vol. xxi. pp. 107-125 and pp. 175-190.—On a certain class of groups of transformation in space of three dimensions, by H. F. Blichfeldt, is the carrying on of an investigation (by S. Lie) of groups of transformations in 3 variables, defined by the properties : two points have one, and only one, invariant ; $s > 2$ points have no invariants independent of such two-point invariants. This class belongs to a wider class in n variables defined by the properties : not less than $m > 1$ points may possess invariants, while s points, $s > m$, may have no invariants independent of the m-point invariants. The wider class includes the group of Euclidean motions in space of 2 or 3 dimensions, the group of translations in space of n dimensions, the group of Euclidean motions and similar transformations in space of 3 dimensions, &c. Certain groups are discussed and their general properties stated.—Dr. L. E. Dickson, in a paper on the canonical form of a linear homogeneous substitution in a Galois field, gives a short proof by induction of a result which M. Jordan had previously obtained by a rather lengthy analysis.—Dr. E. O. Lovett writes on families of transformations of straight lines into spheres. If a plane σ containing two points E and E_1 moves upon a coincident plane σ_1 containing two straight lines g and g_1, so that E remains upon g and E_1 upon g_1, the two planes form a mechanism possessing the following well-known properties : Every point of σ traces an ellipse upon σ_1, and every point of σ_1 traces a limaçon upon σ (*cf.* Chasles, Aperçu, p. 49), a circle c of radius a in σ rolls upon the inner side of a circle c_1 of radius $2a$ in σ_1. Every point of c describes a straight line passing through the centre of c_1. Any two of these lines, with the points which generate them, can be taken for g, g_1 and E, E_1 in defining the movement. Mr. E. M. Blake's object, in his article on the Ellipsograph of Proclus, is to study (1) the curves generated by the points of σ and σ_1 ; (2) the ruled surfaces generated by any straight line carried by σ or σ_1 and not parallel to them ; (3) the curves enveloped by any straight line of σ or σ_1 ; (4) the developables enveloped by carried planes (*cf.* Cayley, on the kinematics of a plane, *Q.J.* xvi. 1878 ; Schell, "Theorie der Bewegung und Kräfte," i. pp. 227-230, and articles by Burmester).—Mr. N. J. Hatzidakis, in displacements depending on one, two, . . . k parameters in a space of n dimensions, extends to the general case results obtained for 4 dimensions by Prof. Craig (vol xx. 2) and M. Darboux.—The main object of Dr. G. A. Miller on the product of two substitutions is to prove the following theorem :—If l, m, n are any three integers greater than unity, of which we call the greatest k, it is always possible to find three substitutions (L, M, N) of $k + 2$ or some smaller number of elements, and of orders l, m, n respectively, such that $LM = N$.

Annalen der Physik, No. 4.—Temperature and potential gradient in rarefied gases, by G. C. Schmidt. When a vacuum tube is heated, the positive light becomes stratified. The stratifications increase in breadth as the temperature increases. Eventually, the positive light retires towards the anode, so that the discharge becomes dark. At the kathode, on the other hand, an increase of the temperature produces an extension of the glow light, such as is produced by an increase of the current strength. When the dark discharge has set in, the potential gradient is greatest at the anode, and is proportional to the distance from the kathode.—Mechanical motions under the influence of kathode rays and Röntgen rays, by L. Graetz. Rotations similar to those produced by Quincke in liquids may be produced in air ionised by X-rays, by mounting light dielectric bodies provided with agate caps on needle points in the space between two condenser plates exposed to the rays. The sense of the rotation depends upon the initial tendency, except when the rotating body contains a metallic substance, in which case the direction of rotation depends upon the direction of the rays and the electric field. The rotations are explained by the electrostatic forces between the wall of the tube and the parts of the body charged by the ions. The author believes that these rotations furnish an explanation for the rotations under the influence of kathode rays first observed by Crookes.—Atomic and molecular magnetism, by S. Meyer. Special investigations of the magnetic susceptibilities of copper compounds have shown that there is no essential difference between cupric